F ENT COOPERATION TREA

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing: 16 November 2000 (16.11.00)	
International application No.: PCT/GB99/01470	Applicant's or agent's file reference: D/1PR01L/P0039/WOD
International filing date: 10 May 1999 (10.05.99)	Priority date:
Applicant: DAWSON, Colin et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International preliminary Examining Authority on:

14 August 2000 (14.08.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer:

J. Zahra

Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
D/1PR01L/P0039/WOD		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/GB 99/01470	10/05/1999	
Applicant		
THE SECRETARY OF STATE FOR DEFENCE et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language,** the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

   [ ] as suggested by the applicant.

   [ ] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [X] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
PCT 99/01470

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B32B7/02 B65D75/58

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B32B B65D A61F B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 397 316 A (ANDES WILLIAM S ET AL) 14 March 1995 (1995-03-14) column 4, line 11 -column 5, line 57	1-17
A	US 3 890 974 A (KOZAK THEODORE F) 24 June 1975 (1975-06-24) the whole document	1-17
A	US 5 865 824 A (CHEN FUNG-JOU ET AL) 2 February 1999 (1999-02-02) abstract; claims	1-17
A	US 5 873 868 A (NAKAHATA HIROSHI) 23 February 1999 (1999-02-23) claims	1-17

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 January 2000	02/02/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	De Jonge, S

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PC[redacted] 99/01470

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 741 564 A (GILLBERG-LAFORCE GUNILLA ELSA) 21 April 1998 (1998-04-21) claims	1-17

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/[redacted] 99/01470

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5397316 A	14-03-1995	AU 696126 B	03-09-1998
		AU 7202494 A	17-01-1995
		BR 9406974 A	26-03-1996
		CN 1129395 A	21-08-1996
		CZ 9503462 A	17-07-1996
		EG 20388 A	28-02-1999
		EP 0774941 A	28-05-1997
		FI 956275 A	20-02-1996
		HU 74129 A	28-11-1996
		JP 8511724 T	10-12-1996
		NO 955247 A	26-02-1996
		NZ 268721 A	26-06-1998
		SG 55062 A	21-12-1998
		TR 28268 A	17-04-1996
		WO 9500091 A	05-01-1995
US 3890974 A	24-06-1975	AT 348459 B	26-02-1979
		AT 463475 A	15-07-1978
		AU 8215475 A	23-12-1976
		BE 830344 A	17-12-1975
		CA 1035902 A	08-08-1978
		CH 592421 A	31-10-1977
		DE 2525987 A	02-01-1976
		DK 273075 A,B,	19-12-1975
		FR 2275313 A	16-01-1976
		GB 1503207 A	08-03-1978
		JP 948062 C	20-04-1979
		JP 51014436 A	04-02-1976
		JP 53027656 B	09-08-1978
		NL 7507200 A	22-12-1975
		NO 752159 A,B,	19-12-1975
		SE 400022 B	13-03-1978
		SE 7506953 A	19-12-1975
		ZA 7503887 A	26-05-1976
US 5865824 A	02-02-1999	AU 6785298 A	13-11-1998
		WO 9847455 A	29-10-1998
		ZA 9802481 A	30-09-1998
US 5873868 A	23-02-1999	WO 9962448 A	09-12-1999
US 5741564 A	21-04-1998	CA 2179763 A	23-12-1996
		US 5839608 A	24-11-1998

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

SKELTON S R
D/IPR
Formalities Section (DERA)
Poplar 2, MOD Abbey Wood No 19
Bristol BS34 8JH
GRANDE BRETAGNE

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Rule 71.1)

Date of mailing *(day/month/year)*	14.12.2000
Applicant's or agent's file reference 1L/P0039/WOD	**IMPORTANT NOTIFICATION**

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB99/01470	10/05/1999	10/05/1999

Applicant
THE SECRETARY OF STATE FOR DEFENCE et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/	Authorized officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Ridé, M-C Tel.+49 89 2399-8082

Form PCT/IPEA/416 (July 1992)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
1L/P0039/WOD		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB99/01470	10/05/1999	10/05/1999
International Patent Classification (IPC) or national classification and IPC B32B7/02		
Applicant THE SECRETARY OF STATE FOR DEFENCE et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
14/08/2000	14.12.2000
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Okunowski, J Telephone No. +49 89 2399 8975

Form PCT/IPEA/409 (cover.sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB99/01470

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*:
Description, pages:

1-12 as originally filed

Claims, No.:

1-17 as originally filed

Drawings, sheets:

1/2-2/2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-17
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-17
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-17
	No:	Claims	

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

Item V

For the purposes of Article 33 PCT, the term "smart" in the claims is ignored.
In US-A-5 873 868, sheets are disclosed with reversibly openable pores, which pores, by opening, facilitate the passing of e.g. fluids. These openings open, and close, depending upon a mechanical stress applied to the sheet.

In contrast to this, the slitted material of the present claims contains, at least in the slitted areas, differential fluid absorption properties, which cause, upon fluid absorption, the bending of the material near the slit. This allows the reversible widening of the slit, which, in turn, facilitates the passing of fluids through the sheet. This particular solution to the problem of making reversibly openable apertures in a sheet is suggested in none of the prior art documents.

Thus, the subject-matter of the present claims is novel, and involves an inventive step.

Item VII

The term "deg C" is not the appropriate abbreviation for "°C" (Rule 10.1(e) PCT). Te same applies to the term "gsm" when used for "g/m^2".

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
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EE	Estonia	**LR**	Liberia	**SG**	Singapore		

SMART POROUS FILM OR MATERIAL

The present invention relates to smart films and materials particularly those which can modify their porous properties and can be used in clothing.

When covering objects with a protective film or material it is often desirable for the film or material to be capable of allowing fluids, such as liquids and gases, to pass from the object through the film or material to the surrounding environment.

Examples of this requirement can be found particularly in clothing where a variety of Moisture Vapour Permeable (MVP) materials are known which allow water vapour to pass through the garment thus removing a proportion of the sweat generated by a wearer. These materials are also widely used in the medical field in the form of bandages and dressings. Also known are materials such as Stomatex (RTM) which is a rubber material having a number of perforations spread throughout the material. The material has pockets below each perforation configured so as to allow a local build-up of vapour pressure before allowing the gases through. In both the clothing and medical uses these materials perform their specific function but are limited in that they can only remove gases and vapours and have a limited performance which is constant and does not change in response to environmental changes. Thus under extreme conditions the material will not be able to function satisfactorily. Clothing includes gloves, hats and footwear.

An aim of the present invention is to provide a smart porous film or material which automatically controls its porous properties in

relation to changes in its local environment thus allowing fluids to pass through the film or material in a controlled fashion.

Accordingly, the present invention provides a smart film or material comprising at least two layers having different fluid absorption properties wherein all the layers are cut so as to provide a plurality of close fitting flaps through the film or material such that any strain differences between the layers caused by their different fluid absorption properties will cause the flaps to bend providing a plurality of openings in the layer.

As an alternative, the present invention also provides a smart film or material comprising a layer, a surface of which has discrete areas which have fluid absorption properties different to the rest of the layer wherein the discrete areas and the layer which they cover are cut so as to provide a plurality of close fitting flaps through the film or material such that any strain difference between the discrete areas and the layer which they cover, caused by their different fluid absorption properties, will cause the flaps to bend thus providing an opening in the layer.

The bending of the flaps is a result of the layers having different affinities for a fluid in the local atmosphere or the discrete areas having a different affinity for a fluid than layer which they cover.

One example of this effect is where a discrete area has different hydrophilic properties to the layer it covers or the layers have different hydrophilic properties to each other.

In a more specific example a discrete area could be arranged to take in more water or water vapour from the local atmosphere than the layer which it covers it then expands causing a strain difference between it and the layer which it covers. This strain difference causes the flaps to bend in the most energetically favourable direction.

The advantage of the above is that a film or material whose porosity can change in a controlled manner in response to changes in its local environment is provided.

In use the layer or one of the layers can be substantially impermeable such that fluids cannot pass through the film or material except via the openings caused through the film or material. Alternatively the layer or one of the layers can be permeable, in such an embodiment the amount of fluid which can pass through the film or material is increased or decreased by the opening or closing of the flaps through the film or material.

Advantageously one of the layers can be made of a polymer fibre with increased fluid absorption properties such as a polyethylene oxide macromolecular polymer covered by nylon such as Hygra ™.

The discrete areas can be produced in the form of materials individually deposited on a surface of the layer, possibly using some form of chemical bond, by a printing process such as dot printing, by transfer coating or spread coating or by any other means which is capable of accurately depositing small amounts of a material on a surface. Alternatively the discrete areas can be produced by an etching process whereby a further layer is attached

to the surface of the layer and areas of the further layer are etched away to leave the discrete areas.

The discrete areas deposited on a surface of the layer can be a hydrophilic gel or gel mixture or other suitable material. Such materials may contain, singly or in combination, polyvinyl alcohol, partially hydrolysed polyvinyl acetate, poly(vinylpyrrolidone), polyethylene glycol, ethoxylated polyethylene glycol, polysiloxane, ethoxylated polysiloxane, poly(acrylic acid),copolymers of acrylic acid, poly(N-isopropylacrylamide), poly(2-acrylamide-2-methylpropanesulphonic acid), collagen, gelatin, pectin, starch, in each case optionally cross-linked by incorporation of an appropriate physical cross-linking agent, e.g. borax, or chemical cross-linking agent, e.g. ethylene-bis-acrylamide, and suitable catalysts, e.g. lactic acid, or free radical initiators, e.g. azo-bis-isobutyronitrile, and compatible vegetable or mineral fillers, as has all been described in literature regarding such materials.

The discrete areas can also be formed by locally modifying the layer's fluid absorption properties thus avoiding the need to bond the discrete areas to the layer this can be done by plasma treating a surface of the layer or by treating a surface of the layer with chemicals or radiation. For example, exposing a material composed of an uncrosslinked polymer to a source of high energy radiation (such as UV light or gamma rays) or ionic particles (such as a plasma) it is possible to form crosslinks between the polymer molecules. If the initial starting material is hydrophilic it will be made more hydrophobic by this treatment and the material may also become stiffer.

Advantageously the discrete areas can be only a few millimetres in diameter and can be dispersed over the entire layer, or in specific locations of the layer, in a density defined by the level of porosity required of the film or material. The size of the discrete areas will in practice be limited by manufacturing techniques and the ability to make accurate, small cuts through the film or material.

Obviously larger discrete areas can be provided should large openings be required such as would be needed to allow liquids instead of gases to pass through the film or material.

The cutting of the flaps is preferably done so as to form a plurality of flaps which are located in a close fitting arrangement, i.e. the amount of material removed during cutting should be kept to a minimum. This is advantageous as it aims to maintain as much of the properties of the uncut film or material as is possible. Usefully this can be done using laser, water jet or punching techniques.

Any number of close fitting flaps can be provided at a single location in the film or material however a minimum of 3 flaps will allow the flaps to bend easily providing an opening. Further flaps would increase the size of opening produced at each location, however, the cutting procedure increases in complexity, and the amount of material removed will be increased, as more cuts are needed. The removal of more material will increasingly affect the overall properties of the film or material when the flaps are closed.

An additional improvement of the invention can be obtained by causing a further discrete area which has fluid absorption properties different to the rest of the layer to be formed, which individually surrounds some or all of the discrete areas and is disposed from the discrete area it surrounds. This can be done in the form of a hoop. When the environment adjacent to a further discrete area changes the strain differences between the layer and the further discrete area, as a result of their different fluid absorption properties, causes a pocket or bulge to form in the film or material. Provision of a pocket or bulge beneath the opening formed by the flaps may improve the efficiency of the proposed system. For example, when the pocket or bulge is formed the concentration of a gas, such as water vapour, could be allowed to build up to high levels before the flaps formed in the discrete area are caused, as a result of strain differences between the layers of the flap, to bend thus forming an opening. Once the opening has formed gas exchange between the pocket or bulge and the environment can occur by a process of diffusion. Diffusion is driven by concentration gradients and as such this process of gas exchange is increased by the high concentration of gas in the pocket or bulge and would quickly reduce the level of gas inside the chamber thus allowing the flaps to close. This also reduces the amount of time that the flaps are required to be open.

A film or material according to the present invention can be used in a variety of applications. These applications include use in clothing, medical applications, food wrappings and structures such as tents and garden cloches.

When in use as a clothing material the material can be arranged to have a predetermined porosity which will be capable of being increased by the opening of the flaps in response to changes in the local environment caused by the actions of the wearer. This could possibly be as a result of an increase in the workload of the wearer causing the wearer to become hotter thus requiring an increased amount of fluid, either in the form of moisture vapour or sweat, to be removed from the body. This opening of the flaps could be arranged to occur as a response to an average level of fluid absorption in the film or material or only to occur at extreme levels to reduce heat stress under heavy exertion.

Medical uses of a film or material according to the present invention include uses in bandages or dressings for wounds where it is desirable to either keep the covered area dry or allow gases to escape from the covered area. Again a film or material could be arranged such that the flaps open under average conditions or the flaps could be arranged to open only under extreme conditions.

Uses as food wraps are similar to the medical uses where food needs either to be kept dry or free from a build up of gases. Particular uses in food wraps are where the film or material absorbs gases naturally emitted from the food causing pores to open and thus allowing the gases to be released.

When used in structures such as tents or garden cloches the film or material can prevent the build up of condensation on the inside of the structure or it can allow gases given off from within the structure to escape.

As stated the film or material will be made more porous by the cuts made in it, even when the resulting flaps are closed, unless these cuts can be made to be so close fitting so as to render them impermeable or the cuts are made under tension such that when released the flaps are in close contact with each other. As such the smart film or material may be required to be combined with further materials, possibly using moisture vapour permeable materials or tufted, embedded or woven hairs or fibres, to provide the required overall properties. Another material which could be used is a fur-mimetic material acting as an outer layer to provide protection from rain.

Various materials can be used to produce smart porous textiles according to the present invention. Materials which absorb water and could be coated onto or extruded with a non-absorbing layer include Polyurethanes, Polyether block amides (PEBA), Hydrogels and Water Soluble polymers such as polyvinylpyrrolidone, carboxyl methyl cellulose and polyvinyl alcohol.

The following are, by way of example only, four examples of methods of manufacturing materials in accordance with the present invention:

Example 1

A 2x2 200 gsm polyester plainweave fabric is passed through a solution of primer and after drying is stippled with a jet printer dot paste coating and immediately contacted with a powder comprising a 1:1 dry blend of polyvinyl alcohol and polyacrylic acid, pressure being applied by a heated roll at 170 deg C.

The resulting 5mm diameter adhered disks are present at a surface density of two per square centimetre in a regular grid pattern.

The fabric is subsequently passed intermittently through the work zone of a focused and collimated indexing Carbon Dioxide laser which irradiates each disk area in turn producing cruciform slots each 0.3mm in width and 3mm in length through the disk area.

Example 2

A previously degreased 300gsm polyester cored cotton plainweave fabric is passed through the Nitrogen atmosphere work zone of an indexed scanning electron beam (300KeV, 15mA) traversing the full width of fabric at a lateral sweep velocity of 25m/min.

Acrylic Acid is sprayed onto one side of the fabric in striated zones and the fabric passed through a drying oven at 100 deg C with a residence time of 10 minutes followed by cooling to room temperature over a further 10 minutes with fan assist.

The add on weight of polyacrylic acid is 200 gsm in the areas treated.

The fabric is subsequently punched with a cruciform pattern in the region of the striations only to give a pore density of one pore per square centimetre, the pores being 5mm long in each orthogonal direction.

Example 3

A previously degreased 300gsm polyester cored cotton plainweave fabric is activated by electron beam exposure in selected zones and is then fully coated with N-vinylpyrrolidone containing 0.5%

by weight of N.N-mythylene-bis-acrylamide. The fabric could also be activated chemically by treatment with any of peroxydisulphuric acid, chromic acid, ferric chloride/hydrogen peroxide or peroxyacetic acid.

The fabric is passed through a ventilated drying oven at 70 degrees C with residence time of 10 minutes followed by a further 10 minutes cooling with fan assist.

The fabric is then passed through a water bath with agitation to dissolves away the unfixed coating leaving a fabric having poly(N-vinylpyrrolidone) coating (200gsm) in irradiated zones only.

The fabric is then punched to form cruciform cuts.

Example 4

An A4 specimen of 60gsm microfibre polyester woven fabric is laid on foil and the exposed surface treated for 10 minutes in a cold plasma barrel reactor with a maintained rarefied atmosphere of nitrogen containing 20% v/v N-vinylpyrrolidone (0.05 Torr) excited by a 100W microwave field (433MHz).

The polyester fabric is then exposed to a scanning and indexing CO2 laser to receive cruciform cuts.

The textile has become hydrophilic on one side, while remaining hydrophobic on the other.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings, wherein

Fig 1. Shows a plan view of a smart porous material according to the present invention, the stippled areas indicating the smart discrete areas of the material.

Fig 2. Shows a section A-A through the material shown in figure 1.

Fig 3. Shows the same cross section as in figure 2 following opening of the flaps.

Fig 4. Shows a plan view of an improved smart porous material according to the present invention, the stippled areas indicating the smart discrete areas of the material.

Fig 5. Shows a section B-B through the material shown in figure 4.

Fig 6. Shows the same cross section as in figure 5 following formation of the pocket and opening of the flaps.

A smart porous material according to the present invention is shown in figure 1 and comprises a layer (1), on which is arranged humidity sensitive discrete areas (2) which have different hydrophilic properties to the layer. These areas can be produced by plasma treatment of specific areas of the layer. Thus changing the hydrophilic properties of a relatively thin area (2) at the surface of the layer (1). The humidity sensitive discrete areas are arranged and sized so as to fit as many discrete areas on the layer as is required to give the necessary porous properties. Each discrete area and the layer beneath it is then cut, using laser

techniques in the form of a cross (3), thus providing 4 flaps (4 a, b, c & d), two of which are shown in cross section in figure 2. When the humidity of the environment adjacent to a humidity sensitive discrete area increases the flaps will be caused to bend due to the strain differences caused by the different hydrophilic properties of the layer and discrete area, as shown in figure 3, thus causing an opening(5) to be formed in the material and causing the material as a whole to become more porous. When the humidity of the environment adjacent to the same discrete area decreases it will cause the flaps to straighten thus closing the opening and causing the material as a whole to become less porous, as shown in figure 2.

An improvement of the invention can be obtained by causing a further humidity sensitive discrete area (6), as shown in figures 4 and 5, to be formed in a hoop outside some or all of the discrete areas (2). As shown in figure 6, when the humidity of the environment adjacent to a further discrete area increases the strain differences between the layer (1) and further discrete area (6), as a result of their different hydrophilic properties, causes a pocket (7) as well as the hole (5) to form in the material thus increasing the overall material's ability to transfer moisture. The hole (5) and the pocket (7) can be arranged to form at a similar humidity level or at different humidity levels.

CLAIMS

1. A smart film or material comprising at least two layers having different fluid absorption properties wherein all the layers are cut so as to provide a plurality of close fitting flaps through the film or material such that any strain differences between the layers caused by their different fluid absorption properties will cause the flaps to bend providing a plurality of openings in the layer.

2. A smart film or material comprising a layer, a surface of which has discrete areas which have fluid absorption properties different to the rest of the layer wherein the discrete areas and the layer which they cover are cut so as to provide a plurality of close fitting flaps through the film or material such that any strain difference between the discrete areas and the layer which they cover, caused by their different fluid absorption properties, will cause the flaps to bend thus providing an opening in the layer.

3. A smart film or material according to claims 1 or 2 configured so as to be suitable for use in clothing.

4. A smart film or material according to claim 2 or 3 wherein the discrete areas are produced by attaching a material having different fluid absorption properties to the layer to the surface of the layer.

5. A smart film or material according to claim 2 or 3 wherein the discrete areas are areas of the layer which have been plasma

treated or treated with chemicals or radiation so as to modify their fluid absorption properties.

6. A smart film or material according to claim 2 or 3 wherein the discrete areas are provided by a printing process.

7. A smart film or material according to claim 2 or 3 wherein the discrete areas are provided by an etching process.

8. A smart film or material according to any of the preceding claims wherein the discrete areas and the layer which they cover or all the layers are cut using a laser or a punch.

9. A smart film or material according to any of the preceding claims wherein the discrete areas and the layer which they cover or all the layers are cut so as to provide at least 3 close fitting flaps through the film or material.

10. A smart film or material according to claim 2 or 3 wherein at least some of the discrete areas are individually surrounded by a further discrete area which has fluid absorption properties different to the rest of the layer, the further discrete area being disposed from the discrete area which it surrounds.

11. A smart film or material according to claim 10 wherein at least one of the further discrete areas is provided in the form of a hoop.

12. A smart film or material according to any of the preceding claims wherein the layer or one of the layers is substantially impermeable.

13. A smart film or material according to any of the preceding claims wherein the layer or one of the layers is permeable.

14. A smart film or material according to any of the preceding claims which forms one element of a multi-element textile.

15. A smart film or material according to claim 1 or 3 wherein the layers have different hydrophilic properties to each other.

16. A smart film or material according to claim 2 or 3 wherein the layer and the discrete areas have different hydrophilic properties.

17. A smart film or material as hereinbefore described with reference to the figures 1 to 3 or figures 4 to 6.

FIGURE 1

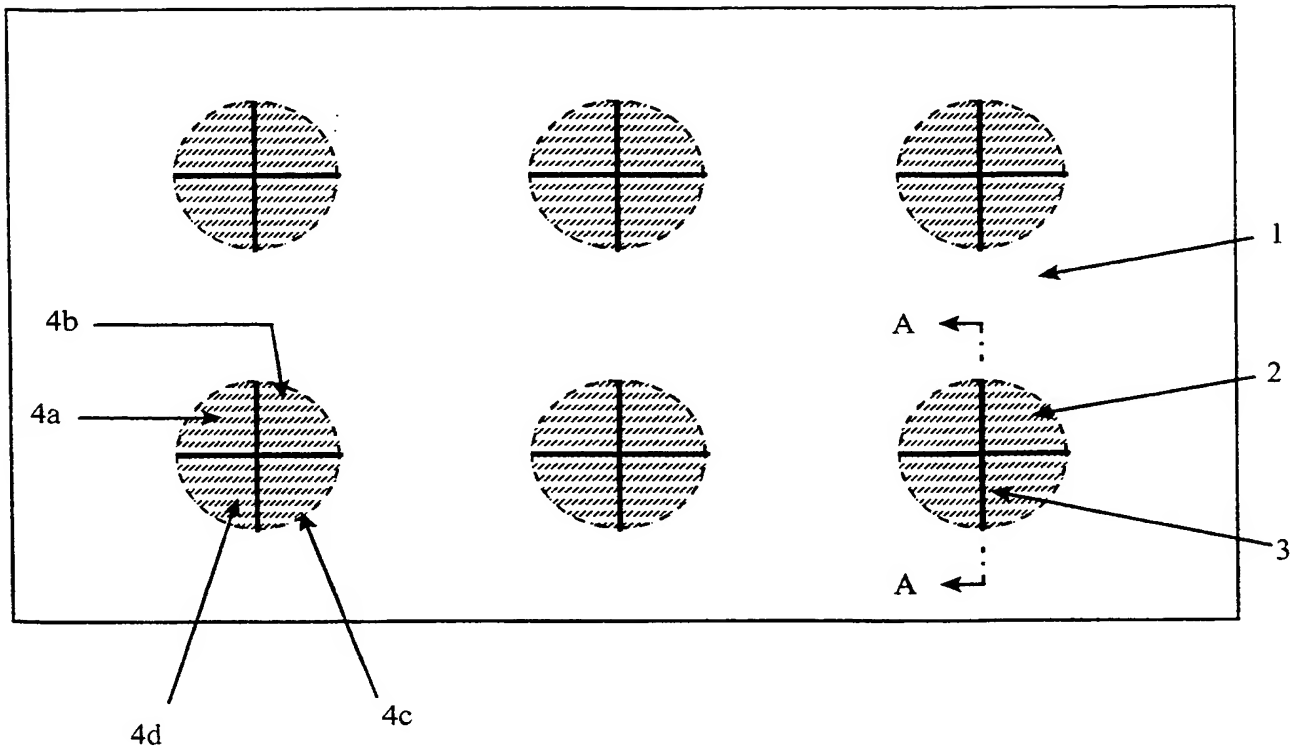


FIGURE 2

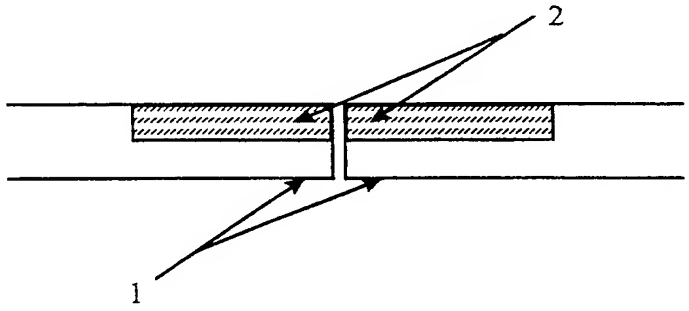


FIGURE 3

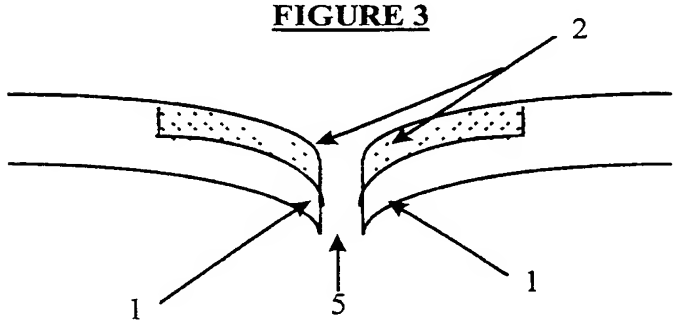


FIGURE 4

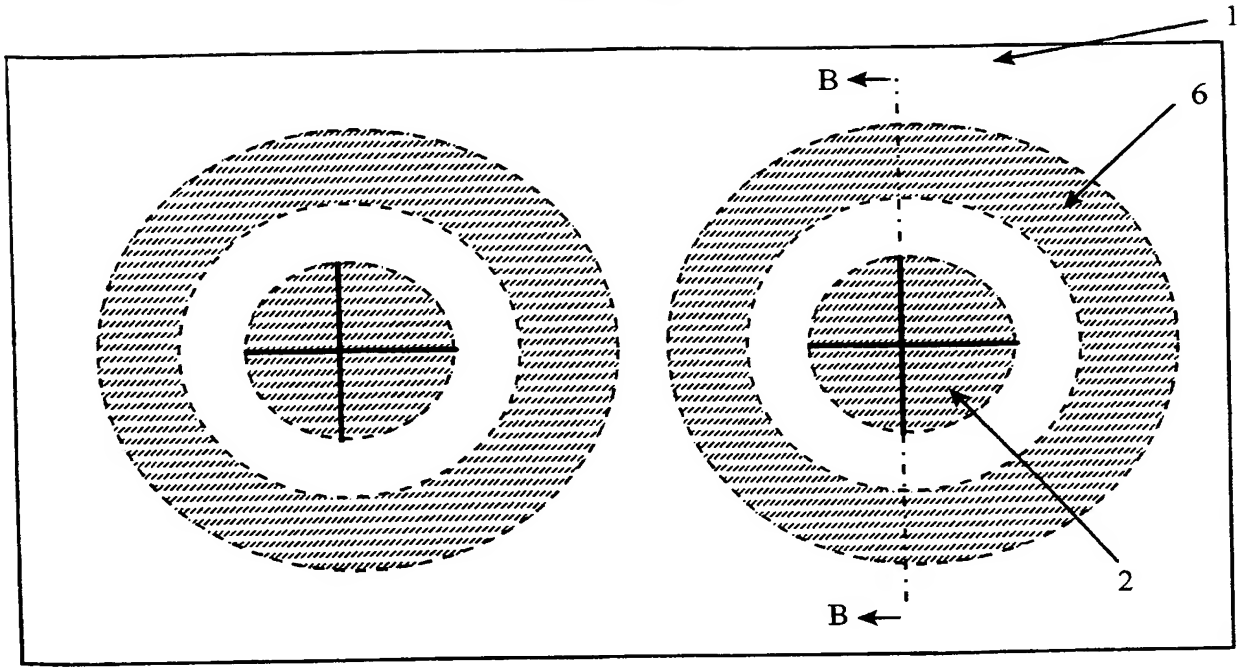


FIGURE 5

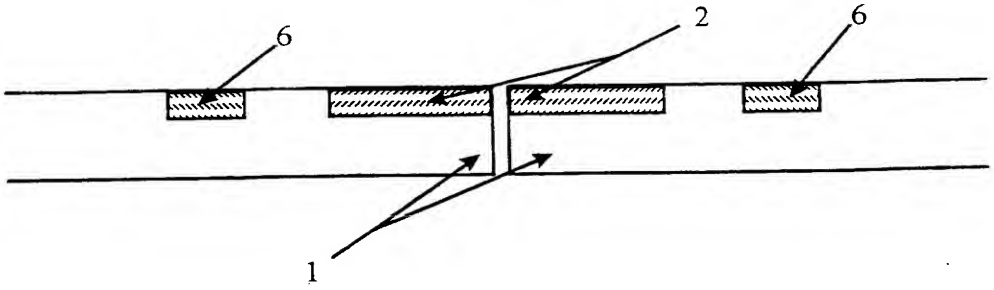
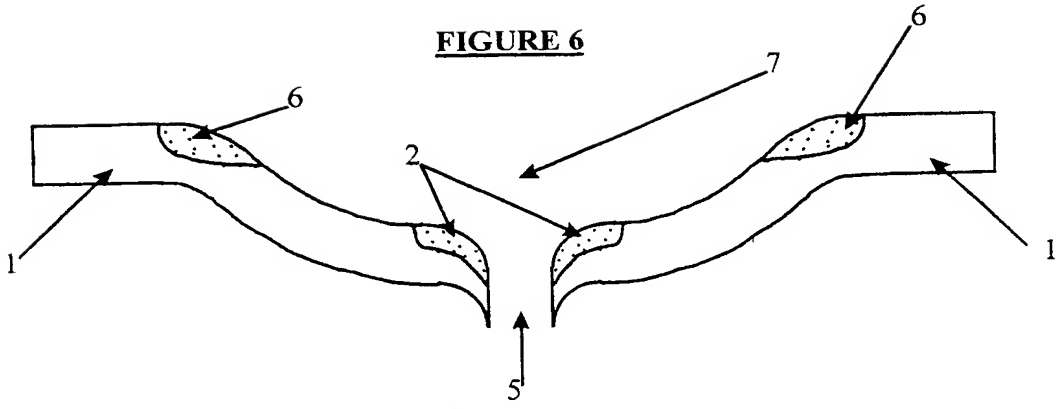


FIGURE 6



INTERNATIONAL SEARCH REPORT

Inte. Application No
PCT/GB 99/01470

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B32B7/02 B65D75/58

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B32B B65D A61F B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 397 316 A (ANDES WILLIAM S ET AL) 14 March 1995 (1995-03-14) column 4, line 11 -column 5, line 57	1-17
A	US 3 890 974 A (KOZAK THEODORE F) 24 June 1975 (1975-06-24) the whole document	1-17
A	US 5 865 824 A (CHEN FUNG-JOU ET AL) 2 February 1999 (1999-02-02) abstract; claims	1-17
A	US 5 873 868 A (NAKAHATA HIROSHI) 23 February 1999 (1999-02-23) claims	1-17

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 January 2000	02/02/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	De Jonge, S

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INTERNATIONAL SEARCH REPORT

Inte[redacted]pplication No
PCT/GB 99/01470

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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